

NATURAL RESOURCES CONSERVATION SERVICE CONSERVATION PRACTICE STANDARD

OPEN CHANNEL

(Ft.)

CODE 582

DEFINITION

Constructing or improving a channel either natural or artificial in which water flows with a free surface.

PURPOSE

To provide discharge capacity required for flood prevention, drainage, other authorized water management purposes, or any combination of these purposes.

CONDITIONS WHERE PRACTICE APPLIES

This standard applies to construction of new channels or modifications of existing channels.

It applies where stability requirements can be met, where the impact of the proposed construction on water quality, fish and wildlife habitat, forest resources and quality of the landscape is evaluated, and the techniques and measures necessary to overcome the undesirable effects are made part of any planned work. It is also necessary to provide an outlet for discharge by gravity flow or pumping and where excavation or other channel work does not cause significant erosion, flooding, or sedimentation.

This standard does not apply to short reaches of streams that should be treated by using Streambank and Shoreline Protection (580) or Stream Channel Stabilization (584).

CRITERIA

General Criteria Applicable to All Purposes

Channel construction or modification shall be according to an approved plan prepared for the site.

Design of Open Channels (TR-25) shall be used in surveys, planning, and site investigations for channel work. Design criteria in TR-25 shall be followed using the procedure best adapted to site conditions.

The quality of the landscape shall be maintained by both the location of channel works and plantings, as appropriate.

Measures and construction methods that enhance fish and wildlife values shall be incorporated as needed and practical. Special attention shall be given to protecting and maintaining key shade, food, and den trees. Where possible, limit construction to one side only.

Planned measures necessary to mitigate unavoidable losses to fish or wildlife habitat shall be included in the project.

The alignment of channels undergoing modification shall not be changed to the extent that the stability of the channel or laterals thereto is endangered.

Capacity. The capacity for open channels shall be determined according to procedures applicable to the purposes to be served and according to related engineering standards and guidelines in handbooks. The water surface profile or hydraulic grade line for design flow shall be determined according to guidelines for hydraulic design in TR-25. The "n" value for aged channels shall be based on the expected vegetation, along with other retardance factors, considering the level of maintenance prescribed in the operation and maintenance plan prepared with the owners or sponsors. The required capacity shall be established by volume-duration removal rates, peak flow, or a combination of the two, as determined by the topography, purpose of the channel, desired level of protection, and economic feasibility.

Cross Section. The required channel cross section and grade shall be determined by the plan objectives, the design capacity, the materials in which the channel is to be constructed, the vegetative establishment program, and the requirements for operation and maintenance. A minimum depth may be required to provide adequate outlets for subsurface drains, tributary ditches, or streams.

Channel Stability. Characteristics of a stable channel are:

- The channel neither aggrades nor degrades beyond tolerable limits
- The channel banks do not erode to the extent that the channel cross section is changed appreciably
- Excessive sediment bars do not develop
- Gullies do not form or enlarge because of the entry of uncontrolled surface flow to the channel

All channel construction and modification (including clearing and snagging) shall be according to a design that can be expected to result in a stable channel that can be maintained at reasonable cost. Vegetation, riprap, revetments, linings, structures, or other measures shall be used, if necessary, to insure stability.

The method in TR-25 applicable to site conditions shall be used in determining the stability of proposed channel improvements.

Bankfull flow is the flow in a channel that creates a water surface at or near the normal ground elevation, the tops of dikes, or continuous spoil banks that confine the flow for a significant length of a channel reach.

Channels must be stable under conditions existing immediately after construction (as-built condition) and under conditions existing during effective design life (aged condition). Channel stability shall be determined for discharges under these conditions as follows:

- As-built condition – Bankfull flow, design discharge, or 10-year-frequency flow, whichever is smallest, but not more than 150 percent nor less than 50 percent of design discharge.

The allowable as-built velocity (regardless of type of stability analysis) in the newly constructed channel may be increased by a maximum of 20 percent if:

- The soil and site in which the channel is to be constructed are suitable for rapid establishment and support of erosion-controlling vegetation
- Species of erosion-controlling vegetation adapted to the area and proven methods of establishment are known
- The channel design includes detailed plans for establishing vegetation on the channel side slopes
- Aged condition – Bankfull flow or design discharge, whichever is larger, except that it is not necessary to check stability for discharge greater than the 100-year frequency.

Stability checks that are flow-related are not required if the velocity is 2 ft/s (0.6 m/s) or less.

For newly constructed channels in fine-grained soils and sand, the “n” values shall be determined according to procedures in Chapter 6 of TR-25, and shall not exceed 0.025. The “n” value for channels to be modified by clearing and snagging only shall be determined by reaches according to the expected channel condition upon completion of the work.

Appurtenant Structures. The channel design shall include all structures required for proper functioning of the channel and its laterals, as well as travelways for operation and maintenance.

Inlets and structures needed for entry of surface and subsurface flow into channels without significant erosion or degradation shall be included in the channel design. The design also shall provide for necessary flood gates, water-level-control devices, bays used in connection with pumping plants, and any other appurtenances essential to the functioning of channels and contributing to attainment of the purposes for which they are built. If needed, protective structures or treatment shall be used at junctions between channels to ensure stability at these critical locations.

The effect of channel work on existing culverts, bridges, buried cables, pipelines, irrigation flumes, and inlet structures for surface and subsurface drainage on the channel and laterals thereto shall be evaluated to determine the need for modification or replacement.

Culverts and bridges that are modified or added as part of channel projects shall meet reasonable standards for the type of structure and shall have a minimum capacity equal to the design discharge or state agency design requirements, whichever is greater. Capacity of some culverts and bridges may need to be increased above the design discharge.

Disposition of Spoil. Spoil material from clearing, grubbing, and channel excavation shall be disposed of in a manner that will:

- Not confine or direct flows so as to cause instability when the discharge is greater than the bankfull flow
- Provide for the free flow of water between the channel and floodplain unless the valley routing and water surface profile are based on continuous dikes being installed
- Not hinder the development of travelways for maintenance
- Leave the right-of-way in the best condition feasible, consistent with the project purposes and adjacent land uses
- Direct water accumulating on or behind spoil areas to protected outlets
- Maintain or improve the visual quality of the site to the extent feasible

Vegetation. Vegetation shall be established on all channel slopes, berms, spoil, and other disturbed areas according to Critical Area Planting (342).

Specific Criteria for Urban Areas

Channels or channel systems shall be designed so that peak discharges are consistent with the level of protection required, but in no case shall the bankfull elevation contain less than the 10-year frequency discharge, and:

- The water surface elevation attained during the passing of the runoff from a 100-year frequency, 24-hour duration storm shall be such that all floors of living units or commercially used buildings will be free

from water. The water surface elevation attained during the passing of the runoff from a 50-year frequency, 24-hour duration storm shall be such that no water enters openings of basements that contain no dwelling units. Runoff from a storm of this frequency and duration shall not affect any habitable building adversely

- Streets shall remain useable during runoff from a storm equivalent to a 10-year return frequency of a 24-hour duration.

Peak rates of runoff for drainage areas up to 2,000 acres shall be determined as outlined in Urban Hydrology for Small Watersheds (TR-55), or by other acceptable methods.

Maintenance Access. Travelways for maintenance generally shall be provided as part of all channel work. This requirement may be met by providing ready access points to sections of the channel if this will permit adequate maintenance in conformance with the operation and maintenance plan.

A travelway shall be provided on each side of large channels if necessary for use of maintenance equipment. Travelways must be adequate for movement and operation of equipment required for maintenance of the channel. The travelway may be located adjacent to the channel on a berm or on the spread spoil. In some places the channel itself may be used as the travelway. The travelway, including access points, must blend into the topography.

Safety. Open channels can create a safety hazard. Appropriate safety features and devices shall be installed to protect people and animals from accidents such as falling or drowning.

CONSIDERATIONS

When planning this practice, consider:

- Possible damages above or below the point of discharge that might involve legal actions or other off-site impacts
- Use of riparian buffers, filter strips, and fencing
- Potential water quality impacts for soluble pollutants and sediment-attached pollutants
- Potential changes in soil moisture that will affect the growth of desirable vegetation

- Effect on ground water recharge and quality of ground water
- Effects on components of the water budget, especially on volumes and rates of runoff and infiltration

PLANS AND SPECIFICATIONS

Plans and specifications for constructing open channels shall be in keeping with this standard and shall describe the requirements for properly installing the practice to achieve its intended purpose.

The following list of Construction Specifications is intended as a guide to selecting the appropriate specifications for each specific project. The list includes most, but may not contain all, of the specifications needed for a specific project:

IA-1	Site Preparation
IA-5	Pollution Control
IA-6	Seeding and Mulching for Protective Cover
IA-21	Excavation
IA-27	Diversions
IA-45	Plastic (PVC, PE) Pipe
IA-51	Corrugated Metal Pipe
IA-52	Steel Pipe Conduits
IA-61	Loose Rock Riprap
IA-92	Fences
IA-95	Geotextile

OPERATION AND MAINTENANCE

An operation and maintenance (O&M) plan must be prepared for each open channel system. Specified actions shall include normal repetitive activities in the application and use of the practice (operation), and repair and upkeep of the practice (maintenance).

Minimum requirements for operation, maintenance, and replacement shall be consistent with the design objectives. This includes consideration of fish and wildlife habitat, quality of the landscape, water quality, mitigation features, methods, equipment, costs, stability, function for design life, frequency, and time of year for accomplishing the work. Detailed provisions for operation and maintenance must be made if complex features such as water level-control structures and pumping plants are required.

Guidance shall be provided on periodic inspections and post storm inspections to detect and minimize damage to the drain and appurtenant structures.

REFERENCES

Iowa Drainage Guide, Iowa State University
Special Report 13

USDA-NRCS, National Engineering Handbook (NEH), Part 650, Engineering Field Handbook (EFH), Chapter 14, Drainage

USDA-NRCS, Design of Open Channels, Technical Release 25 (TR-25)

USDA-NRCS, Urban Hydrology for Small Watersheds, Technical Release 55 (TR-55)